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J. Boritz
School of Accounting and Finance, University of Waterloo, Waterloo, ON, Canada., blhayes@uwaterloo.ca

Louise Hayes
School of Accounting and Finance, University of Waterloo, Waterloo, ON, Canada., jeboritz@uwaterloo.ca

J. Lim
School of Accounting and Finance, University of Waterloo, Waterloo, ON, Canada., jh2lim@uwaterloo.ca

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J. Efrim Boritz
University of Waterloo
jeboritz@uwaterloo.ca

Louise Hayes
University of Waterloo
blhayes@uwaterloo.ca

Jee-Hae Lim
University of Waterloo
jh2lim@uwaterloo.ca

ABSTRACT

By analysing auditors' SOX 404 reports from 2004 to 2009 we find after 2006 that reporting of information technology control weaknesses (ITWs) decreased significantly, primarily by Big 4 firms. This change appears to reflect Big 4 reporting practices in response to a change in auditing standards rather than the nature of Big 4 clients' internal control systems, suggesting that SOX 404 auditors' reports have become less informative. We find associations between ITW reporting and both non-ITW and financial misstatement reporting are moderated by auditor type and time period (2004-2006 vs. 2007-2009). Based on frequency of reporting, the relative ordering of individual ITWs, while differing over time, is similar over auditor type, company size and industry. We identify a small number of non-ITWs in SOX 404 reporting that may hold practical implications for an auditor's consideration of IT control testing and an educator's teaching of IT and non-IT controls.

Keywords

SOX 404, IT control weaknesses; determinants of IT control weakness reporting.

INTRODUCTION

Since the effective date of Section 404 of the Sarbanes-Oxley Act (SOX 404), over 400 adverse auditors' reports on the effectiveness of internal controls over financial reporting disclosing material IT control weaknesses (ITWs) have been filed with the Securities and Exchange Commission (SEC). As a result, it is now possible to study the associations between *specific* ITWs and *specific* non-IT control weaknesses (non-ITWs) and *specific* financial misstatements. Such study is warranted because ITWs are associated with less reliable financial reporting (Curtis, Jenkins, Bedard and Deis, 2009; Messier, Eilifsen and Austen, 2004) and financial misstatements (Klamm and Weidenmier Watson, 2009). An untabulated analysis of *Audit Analytics* data over the 2004-2009 period studied in this paper, shows the significant relationship between ITWs, non-ITWS, and financial misstatements. More specifically, over three quarters of both specific non-ITWs and specific financial misstatements (where counts are sufficient for binomial tests) are reported in proportionately more (p<0.01) first adverse auditors' SOX 404 reports with ITWs than reports without ITWs. The purpose of this study is to deepen our understanding of the impact of material ITWs on internal control and financial reporting by investigating how often *specific* ITWs occur; to what degree frequency of reporting varies over time, auditor type, company size and industry; and how ITWs relate to non-ITWs and financial misstatements.

The four major findings from our study are as follows: (1) ITW reporting in SOX 404 auditors reports changed around the time of auditing standards changes in 2007 (Public Company Accounting Oversight Board (PCAOB)). Consistent with the widely-observed decline in the number of adverse SOX 404 reports (e.g. *Audit Analytics* in its 404 Dashboard Year 4 Update report on SOX 404 filings), we document a downward trend in the number of ITWs reported from 2004 to 2009, with a particularly significant change around 2007, when auditing standards changed. This downward trend is specifically attributable to the drop in the reporting of ITWs rather than non-ITWs, which have remained relatively constant over the six year time period studied. (2) Companies audited by Big 4 auditors (other auditors) report a lower (the same) average number of ITWs per report in the time period after the auditing standard change. Unless this change is due to a significant improvement in the characteristics of weak internal control systems, SOX reporting post-2006 may be less informative compared to early years of SOX reporting. (3) The relative ordering by frequency of occurrence of the ITWs studied (i.e.,

Access, Monitoring and review, Design issues, Segregation of incompatible functions, Change and development, End-user computing, Policies, Masterfiles, Documentation, Staffing sufficiency & competency, Backup, Security (other than over access), Operations, and Outsourcing), while varying with time, does not vary substantively with auditor type, company size, or industry. (4) ITWs co-occur with non-ITWs that are related to segregation of duties and untimely or inadequate account reconciliations. ITWs are also associated with a wide range of financial misstatements.

This study contributes to the academic and professional literature on internal control by providing a granular analysis of ITWs reported in six years of auditors' SOX 404 reports to contribute to our understanding of (i) the factors that influence ITW reporting, (ii) research implications of ITW aggregation, and (iii) associations between ITWs, non-ITWs and financial misstatements. The change in auditors' reporting of ITWs following the effective date of PCAOB Auditing Standard No. 5 (available online at http://pcaobus.org) has implications for both standard setters and academic researchers, as findings for the 2004 to 2006 period may not apply to the post-2006 period. The significant decline in the number of reported ITWs between the early years of SOX 404 reporting and the most recent reporting periods implies a level of improvement in IT controls that merits further investigation. Understanding the determinants and consequences of combinations of associated ITWs and non-ITWs may have implications for ITW identification, reporting, remediation, professional guidance, and academic instruction.

This paper is structured into five sections, including this introduction. The second section provides a review of existing research and develops the proposed research questions. The third section outlines the data sources and methods employed in this study. The fourth section provides descriptive statistics and the results of the statistical analyses related to our research questions. The final section summarizes our findings, limitations and recommendations for future research.

PRIOR RESEARCH AND RESEARCH QUESTIONS

Beginning in 2004, auditors increased their evaluation and testing of controls, including IT controls, in response to requirements introduced under Section 404 of the Sarbanes-Oxley Act. Using reports issued in the first year of SOX 404 reporting (from November 24, 2004 through November 23, 2005), Klamm and Weidenmier Watson (2009) find that companies whose reported internal control weaknesses include at least one ITW report, have more non-ITWs and financial misstatements than companies not reporting any ITWs. Anecdotal evidence suggests that auditors reduced control testing when the PCAOB, working together with the SEC, changed SOX 404 auditing standards effective July 25, 2007 (with earlier adoption permitted) (Curtis et al., 2009). Following this change in standards, auditors were permitted to take a top-down, risk-based approach to evaluation and report on the effectiveness of controls without explicitly assessing managements' tests of internal control.

ITW reporting by auditors depends not only on standards but also on audit firms' control testing approaches and the training and support of IT-specialists (Janvrin, Bierstaker and Lowe, 2009). Thus, a difference between Big 4 and other auditors is expected. Negotiations between the auditors and their clients can also affect ITW reporting. The negotiation process with management is thought to act as a screen between control weaknesses that are identified and those that are reported (ITGI, 2006; Wolfe, Mauldin and Chandler, 2009). Also, company size and industry may influence a company's system design choices and the audit approaches of auditors. For example, ERP systems that present unique control risks (Curtis et al., 2009) are more likely used by larger companies in certain industries. These observations lead to our first research question.

RQ1: *What IT weaknesses have been reported in auditors' SOX 404 reports between 2004 and 2009? Is the reporting of specific IT control weaknesses associated with time, auditor type, company size, and industry?*

Non-ITWs are represented by 20 codes in the *Audit Analytics* database, whereas ITWs are represented by a single code. By disaggregating the single ITW code into 14 sub-categories and investigating differences in the pattern of associations between ITWs and non-ITWs and financial misstatements it may be possible to contribute new knowledge to management remediation efforts, practitioner approaches to audit planning and testing, education course development choices, and standard setters' guidance. This leads to our second and third research questions:

RQ2: *Are IT control weaknesses associated with non-IT internal control weaknesses, and if so, how?*

RQ3: *Are IT control weaknesses associated with financial misstatements, and if so how?*

METHOD

Drawing from the *Audit Analytics* database, we gathered SOX 404 auditors' opinions on Internal Controls over Financial Reporting from companies' Form 10-K and 8-K filings with the SEC from 2004 to 2009. For this period, we identified 2,102 observations (454, 492, 417, 356, 240, and 143 companies from 2004 to 2009, respectively) that received adverse internal control opinions with at least one type of internal control problem reported as a weakness. *Audit Analytics* assigns codes to reports that cover a wide range of financial misstatements and internal control weaknesses, but uses only a single code (IC20 Information Technology software, security and access issues) for all ITWs. Therefore, one of the researchers and a graduate student collaboratively coded ITWs into 14 sub-categories (plus an "unspecified" category), following Boritz, Hayes, and Lim (in press), and five COSO component groupings. Since companies may have adverse internal control reports more than once during the six year period studied, to ensure that our significance tests are robust, we performed all significance tests using reports for the subpopulation of 1,426 first adverse reports, the subpopulation consisting of only one (the first) adverse SOX 404 auditor's report for each company.

RESULTS

RQ1 findings

Table 1 summarizes the number of ITWs, non-ITWs and financial misstatements (GAAP/FASB accounting rule failures) by year for companies with or without ITWs. Untabulated analyses based on the first adverse report are consistent with those presented in Table 1. Overall from 2004 through 2009, the number of SOX 404 reports with internal control weaknesses decreased. For the six year period, reports with ITWs (n=387) averaged more non-ITWs (4.79 vs. 3.42) and financial misstatements (4.37 vs. 2.52) than reports without ITWs (n=1715) (p<0.001). In reports without ITWs, the average number of non-ITWs per report is unchanged (p>0.05) between 2004 and 2009 and the average number of financial misstatements per report is smaller in 2009 than in 2004 (p<0.01) (not in the table). In contrast, in reports with ITWs, the number of ITWs and non-ITWS is smaller in 2009 than in 2004 (p<0.01) but the number of financial misstatements is unchanged (p=0.13) between 2004 and 2009 (not in the table).

		2004		2005		2006		2007		2008		2009		Total 2004 –09		
		With ITWs	Without ITWs	With ITWs	Without ITWs	With ITWs	Without ITWs	With ITWs	Without ITWs	With ITWs	Without ITWs	With ITWs	Without ITWs	With ITWs	Without ITWs	All Reports
	Number of reports	99	355	93	399	71	346	62	294	42	198	20	123	387	1715	2102
Non-ITWs[a]	Number	515	1208	507	1347	337	1151	258	1033	159	671	79	453	1855	5863	7718
	Mean	5.2	3.4 ***	5.45	3.38 ***	4.75	3.33 ***	4.16	3.51 *	3.79	3.39	3.95	3.68	4.79	3.42 ***	3.67
	Std. Dev.	2.76	1.45	2.19	1.49	2.12	1.51	1.88	1.66	1.96	1.34	1.61	1.48	2.31	1.5	1.76
GAAP/FASB accounting rule failures[b]	Number	458	945	485	1081	324	865	219	752	138	420	69	261	1693	4324	6017
	Mean	4.63	2.66 ***	5.22	2.71 ***	4.56	2.5 ***	3.53	2.56 **	3.29	2.12 *	3.45	2.12	4.37	2.52 ***	2.86
	Std. Dev.	3.17	1.7	3.16	2.05	3.64	1.93	2.61	1.89	2.87	1.41	2.84	1.48	3.19	1.83	2.26
COSO categories with ITWs[c]	Number	131	n/a	127	n/a	96	n/a	85	n/a	52	n/a	28	n/a	519	n/a	n/a
	Mean	1.32	n/a	1.37	n/a	1.35	n/a	1.37	n/a	1.24	n/a	1.4	n/a	1.34	n/a	n/a
	Std. Dev.	0.53	n/a	0.55	n/a	0.66	n/a	0.71	n/a	0.58	n/a	0.75	n/a	0.6	n/a	n/a
Detailed ITWs[d]	Number	340	n/a	340	n/a	252	n/a	177	n/a	95	n/a	48	n/a	1252	n/a	n/a
	Mean	3.43	n/a	3.66	n/a	3.55	n/a	2.85	n/a	2.26	n/a	2.4	n/a	3.24	n/a	n/a
	Std. Dev.	2.16	n/a	2.15	n/a	2.21	n/a	1.8	n/a	1.65	n/a	1.85	n/a	2.09	n/a	n/a

***, **, * significant repsectively p-value <0.001, 0.01, and 0.05

a. As coded by the *Audit Analytics* database which codes internal control weaknesses appearing in SOX 404 reports using 21 identifiers, one of which (IC20) signifies that there were ITWs but does not specify their precise nature.

b. As coded by the *Audit Analytics* database which codes 26 GAAP/FASB accounting rule failures (financial misstatements).

c. Manually coded using the five COSO categories (Table 2).

d. Manually coded using 15 ITW identifiers (Table 2) following Boritz et al. (in press).

Table 1 Summary Statistics for SOX 404 Auditors' Adverse Reports With and Without Information Technology Control Weaknesses (ITWs) 2004-2009

In additional untabulated analyses, the average number of detailed ITWs per report is smaller in 2009 than in 2004 and this change appears to have occurred between 2006 and 2007 (p<0.05), the year in which auditing standards changed. In contrast, the average number of non-ITWs, financial misstatements, and COSO components with ITWs per report is the same (p<0.05)

for 2006 and 2007 (not in table). Overall, there are fewer significant differences in the average numbers of non-ITWs and financial misstatements in reports with and without ITWs for the three year period after the auditing standard changed (2007-2009) in comparison with the three years before (2004-2006).

Table 1 supports Klamm and Weidenmier Watson's (2009) finding based on 2004 SOX 404 data that companies with ITWs have significantly weaker internal controls than other companies in the 2004-2006 time period. Table 2 presents descriptive statistics for both detailed ITWs and COSO groupings of ITWs for the 2004-2006, 2007-2009, and 2004-2009 time periods. Boritz et al. (in press) report frequent co-reporting of ITWs and study the correlations between ITWs. Four ITWs, Access, Monitoring and review, Design issues and Segregation of incompatible functions account for half (plus or minus 5%) of the reported ITWs. We find that the ordering of the individual ITWs in the 2004-2006 time period differs significantly from the ordering in the 2007-2009 time period (r_s=0.77, n=15, p=.001) and that four ITWs (i.e., Access, Segregation of incompatible functions, Masterfile and Documentation ITWs) are reported relatively less frequently (in comparison with other ITWs) in the 2007-2009 time period than in 2004-2006. The overall (2004-2009) rank ordering by frequency of occurrence is the same for the subpopulation of first adverse reports with ITWs (not tabulated) (r_s =0.99, n=15, p<.001). In other analyses not reported in tables, we compare the rank ordering of ITWs by auditor type, company size and industry and find the orderings are similar across these factors.

	2004 - 2006			2007-2009				2004 - 2009		
	n	% of ITWs	% of reports	n	% of ITWs	% of reports		n	% of ITWs	% of reports
IT Weaknesses (ITWs) [a]										
Access	170	18%	65%	54	17%	44%	***	224	18%	58%
Monitoring & Review	126	14%	48%	45	14%	36%	*	171	14%	44%
Design issues	103	11%	39%	42	13%	34%	ns	145	12%	37%
Segregation of incompatible functions	108	12%	41%	23	7%	19%	***	131	10%	34%
Change and development	89	10%	34%	36	11%	29%	ns	125	10%	32%
End-user computing	87	9%	33%	34	11%	27%	ns	121	10%	31%
Policies	45	5%	17%	22	7%	18%	ns	67	5%	17%
Masterfiles	54	6%	21%	10	3%	8%	**	64	5%	17%
Documentation	43	5%	16%	11	3%	9%	*	54	4%	14%
Staffing sufficiency & competency	28	3%	11%	8	3%	6%	ns	36	3%	9%
Backup	26	3%	10%	10	3%	8%	ns	36	3%	9%
Security (other than over access)	23	2%	9%	7	2%	6%	ns	30	2%	8%
Operations	16	2%	6%	3	1%	2%	b	19	2%	5%
Outsourcing	11	1%	4%	4	1%	3%	b	15	1%	4%
Unspecified	3	0%	1%	11	3%	9%	***	14	1%	4%
Total	**932**	**100%**		**320**	**100%**			**1252**	**100%**	
Number of reports with ITWs	**263**			**124**				**387**		

***, **, *, ns significance respectively p-value <0.001, 0.01, 0.05 and not statistically significant

a. Classified following Boritz et al. (in press).

b. Insufficient counts for statistical comparison.

Table 2 Descriptive Statistics for IT Control Weaknesses (ITWs) in SOX 404 Auditors' Reports 2004-2009

Table 3 reports significance tests for the differences in the average number of non-ITWs, financial misstatements, COSO components and detailed ITWs for subpopulations by auditor type (Big 4 vs. Other auditor) and company size (larger vs. smaller) in first adverse reports with ITWs (ITWeak reports). Table 3 indicates that the average number of non-ITWs and financial misstatements reported in ITWeak SOX 404 reports of Big 4 auditors and larger companies are greater from 2004-2009 than the average number of non-ITWs and financial misstatements of other auditors and smaller companies. These differences are primarily attributable to the 2004-2006 time period (p<0.001). However, Table 3 also indicates that the average number of ITWs per ITWeak report is the same for Big 4 and other auditors (detailed and grouped by COSO components) and for larger and smaller companies (p>0.05) in the 2004-2006 time period. In the 2007-2009 time period Big 4 auditors report a lower average number of ITWs and a higher average number of financial misstatements per ITWeak report

than other auditors (p<0.05). Other analyses (not shown in the table) compares by auditor type and company size the likelihood of auditors reporting any ITWs in all first adverse SOX 404 reports and finds companies engaging non-Big 4 firms and smaller companies are more likely to report ITWs.

		Auditor Type						Company Size[e]					
		2004-2006		2007-2009		2004-2009		2004-2006		2007-2009		2004-2009	
		Big 4	Other	Big 4	Other	Big 4	Other	Larger	Smaller	Larger	Smaller	Larger	Smaller
Number of reports		106	71	22	25	128	96	69	108	16	31	85	139
Non-IT Control Weaknesses[a]	Mean	5.85	4.15 ***	3.55	3.68	5.45	4.03 ***	5.68	4.84 *	3.75	3.55	5.32	4.55 *
	Std. Dev.	2.58	2.06	1.65	2.02	2.59	2.05	3.15	1.97	1.65	1.95	3.01	2.03
GAAP/FASB accounting rule failures[b]	Mean	5.57	2.92 ***	3.68	2.28 *	5.24	2.75 ***	5.36	3.95 **	4.06	2.35	5.12	3.60 **
	Std. Dev.	3.17	2.14	2.92	1.34	3.20	1.97	3.85	2.34	3.36	1.23	3.78	2.21
COSO categories with IT Control Weaknesses[c]	Mean	1.36	1.27	1.18	1.44	1.33	1.31	1.35	1.31	1.25	1.35	1.33	1.32
	Std. Dev.	0.52	0.61	0.50	0.87	0.52	0.69	0.51	0.59	0.58	0.80	0.52	0.64
Detailed IT Control Weaknesses (ITWs)[d]	Mean	3.66	3.28	1.77	3.48 **	3.44	3.33	3.41	3.57	2.12	2.97	3.16	3.44
	Std. Dev.	2.28	2.05	1.41	1.94	2.26	2.01	2.08	2.26	1.63	1.99	2.06	3.21

***, **, * significance respectively p-value <0.001, 0.01, and 0.05

a. As coded by the *Audit Analytics* database which codes internal control weaknesses appearing in SOX 404 reports using 21 identifiers, one of which (IC20) signifies that there were information technology (IT) control weaknesses but does not specify their precise nature. The number of Auditors' SOX 404 reports with IT and non-ITWs identified by manual coding[d] differs from the count based on *Audit Analytics* IC20 code.

b. As coded by the *Audit Analytics* database which codes 26 GAAP/FASB accounting rule failures (financial misstatements).

c. Manually coded using the five COSO categories (Table 3).

d. Manually coded using 15 ITW identifiers (Table 3) following Boritz et al. (in press).

e. Using a median split based on total assets, we classified the companies with internal control weaknesses into larger and smaller companies: 63% of the companies with IT weaknesses were smaller and 37% were larger.

Table 3 Comparison of Average Number of Non-ITWs, Financial Misstatements, COSO Components with ITWs, and Detailed ITWs per Report for First Adverse Reports with ITWs, by Auditor Type and Company Size[e] Over Time

In additional analyses (not shown in the table) we find that the industries with the highest/lowest average number of non-ITWs were not those with the highest/lowest average number of ITWs across the two time periods (classified into sixteen industries using the four-digit SIC codes following Ge and McVay (2005); industries with fewer than 15 (13) companies in the 2004-2006 (2007-2009) time period are excluded. Multivariate analyses used to study RQ2 further explore the relationships between ITWs, non-ITWs, auditor type, and company size.

RQ2 findings

Table 4 defines key variables used in multivariate tests of associations between ITW reporting and non-ITWs and includes variables for auditor type, time period and company size. Additional variables defined in Table 4 are used in multivariate tests of associations between ITW reporting and financial misstatements to investigate RQ3.

While many of the variables in Table 4 are significantly correlated with other variables in Table 4, all pairwise Pearson and Spearman correlation coefficients between variables that are independent variables in multivariate regressions are less than 0.5 (not tabulated). Descriptive statistics for the variables in Table 4 are presented in Table 5.

Variable	Description
ITWs	Natural logarithm of the number of IT-related control deficiencies in SOX 404 auditor report with material weakness(es); 0 if no IT-related control deficiencies are reported.
COSO_ITWs	Natural logarithm of the number of IT-related COSO component weaknesses in SOX 404 auditor report with material weakness(es); 0 if no IT-related control deficiencies are reported.
NonITWs	Natural logarithm of the number of non-IT related control weaknesses in SOX 404 report as reported by *Audit Analytics.*
Misstates	Natural logarithm of the number of GAAP/FASB accounting rule failures (financial misstatements) in SOX 404 report as reported by *Audit Analytics.*
Restates	Equal to 1 if financial statements restated in the year of the SOX report; 0 otherwise.
Post2006	A time period dummy equal to 1 for SOX 404 reports in the 2007 – 2009 time period and 0 for SOX 404 reports in the 2004 – 2006 time period.
Big4	1 if the company is audited by Deloitte & Touche, Ernst & Young, KPMG, or PricewaterhouseCoopers; 0 otherwise.
Assets	Natural logarithm of the assets divided by one million at year-end.

Table 4 Variable Definitions

	First Adverse SOX 404 Auditors Reports With ITWs n=224				First Adverse SOX 404 Auditors Reports Without ITWs n=1202				All First Adverse SOX 404 Auditors Reports n=1426			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
ITWeak	1.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.157	0.364	0.000	10.000
ITWs	0.979	0.699	0.000	2.303	0.000	0.000	0.000	0.000	0.154	0.451	0.000	2.303
COSO_ITWs	0.206	0.354	0.000	1.386	0.000	0.000	0.000	0.000	0.032	0.159	0.000	1.386
NonITWs	1.429	0.593	0.000	2.639	1.137	0.413	0.000	2.565	1.183	0.458	0.000	2.639
Misstates	1.175	0.745	0.000	2.773	0.692	0.637	0.000	2.773	0.768	0.678	0.000	2.773
Restates	0.522	0.501	0.000	1.000	0.621	0.485	0.000	1.000	0.605	0.489	0.000	1.000
Post2006	0.210	0.408	0.000	1.000	0.275	0.446	0.000	1.000	0.264	0.441	0.000	1.000
Big4	0.571	0.496	0.000	1.000	0.777	0.416	0.000	1.000	0.745	0.436	0.000	1.000
Size	0.379	0.486	0.000	1.000	0.522	0.500	0.000	1.000	0.499	0.500	0.000	1.000

Table 5 Descriptive Statistics of Variables Defined in Table 4

The models in Table 6 test associations between ITW reporting (*ITWeak* and *ITWs*), non-ITWs (*nonITWs* and *Audit Analytics* 20 classifications of individual non-ITWs), auditor type (*Big4*), time period (*Post2006*), company size (*Size*) and interactions

of non-ITWs with auditor type, time period and company size. Industry effects were not tested given the limited number of observations.

Dependent Variable		Model 1[a] ITWeak		Model 2[b] ITWeak	
Regression		logistic		logicstic	
	n	coeff.	*t*	coeff.	*t*
Big4	1062	-2.76	-5.10 ***	-0.80	-3.85 ***
Post2006	377	2.09	3.74 ***	0.42	1.67
Size	712	-0.13	-0.24	-0.07	-0.36
NonITWs	1424	1.46	4.40 ***		
NonITWs*Big4	1062	1.23	3.07 **		
NonITWs*Size	712	-0.24	-0.67		
NonITWs*Post2006	377	-2.06	-4.76 ***		
IC11 Segregation of duties * Post2006	49			-1.91	-3.93 ***
IC1 Accounting documentation, policy and/or procedures	1373			-0.92	-2.19 *
IC2 Accounting personnel resources, competency/training	710			0.61	2.93 **
IC3 Ethical or compliance issues with personnel	79			0.43	0.98
IC4 Journal entry control issues	159			-0.07	-0.25
IC5 Remediation of material weakness identified	1				
IC6 Untimely or inadequate account reconciliations	364			1.16	5.70 ***
IC7 Management/Board/Audit Committee investiation(s)	32			0.05	0.08
IC8 Material and/or numberous auditor/year-end adjustments	821			0.09	0.41
IC9 Non-routine transaction control issues	250			-0.10	-0.42
IC10 Restatement or nonreliance of company filings	632			-0.22	-0.97
IC11 Segregation of duties/design of controls (personnel)	240			2.43	10.47 ***
IC12 Insufficient or non-existent internal audit function	41			0.53	1.04
IC13 Scope (disclaimer of opinion or other limitation)	44			1.46	2.95 **
IC14 SEC or other regulatory investiagtions and/or inquiries	4			-1.93	-1.40
IC15 Senior management competency, tone, reliability issues	88			0.14	0.38
IC16 Inadequate disclosure controls	36			-2.63	-2.44 *
IC17 Restatement of previous 404 disclosures	244			-0.22	-0.62
IC18 Ineffective or understaffed audit committee	28			0.53	1.16
IC19 Ineffective regulatory compliance issues	16			-2.18	-1.06
IC21 SAB 108 adjustment	5				
Intercept		-2.52	-5.71 ***	-1.74	0.44 ***
number of observations		1426		1420	
LR Chi-square		188.02		376.20	
p -value		0.0000		0.0000	
Pseudo R squared		0.1516		0.3039	

***, **, * significance respectively p-value <0.001, 0.01, and 0.05

a Big4*Post2006 is not included in Model 1 as the interaction is highly correlated with Post2006 (r=.7541). Interactions Big4*Size, and Post2006*Size are not included as their inclusion does not significantly improve model fit.

b IC11 Segregation of duties*Post2006 is included in Model 2 as inclusion significantly improves model fit while the interaction is not highly correlated with Post2006 (r=.3147). Model fit is not improved by including interactions between individual nonITWs (other than Segregation of duties) with Post2006 and Size .

Table 6 Association of Information Technology Weaknesses (ITWs) with non-ITWs, Auditor Type, Time Period and Company Size in First Adverse SOX 404 Auditors Reports

Model 1 of Table 6 shows the likelihood of reporting one or more ITWs increases as the number of non-ITWs reported increases and that the relationship between ITWs and non-ITWs is moderated by both auditor type (Big 4 vs. Other) and the three-year time period (2004-2006 vs. 2007-2009). Hosmer-Lemeshow goodness of fit tests indicate that model fit is improved when individual non-ITWs replace the number of non-ITWs in the model, specifically,: non-ITWs related to segregation of duties, personnel resourcing and training, account reconciliations, disclosure controls and audit scope or other limitations are associated with ITW reporting. Model 2 fit is not improved (Likelihood-ratio test $p>0.05$) by including the interaction of Big4*Post2006 or other interactions ($r<0.7$ with other independent variables in regressions) between non-ITWs and Big4, Post2006 and Size. Results of an OLS regression (not reported in table) are consistent with those of Model 2 when the dependent variable is replaced with the logarithm of the number of ITWs [$F(24, 1401)=9.79$, Adj. R squared 0.3172]. Model fit of the OLS regression is superior when the measure of severity of ITWs is the number of detailed ITWs reported rather than the number of COSO components (*COSO_ITWs*). Associations are modeled using OLS regressions (dependent variable logarithm of the number of ITWs) rather than Poisson regressions (dependent variable count of number of ITWs) as Poisson dispersion assumptions are violated.

RQ3 Findings

Additional untabulated multivariate analyses show a positive relationship between financial misstatements (*Misstates*) and reporting of ITWs. Model fit is improved when individual financial misstatements replace the number of misstatements. Revenue recognition (an issue that management tends to attribute to material weaknesses along with lack of training, deficiencies in period end reporting processes and accounting policies, lack of segregation of duties, and inappropriate account reconciliation [Ge and McVay, 2005]), receivables/cash, inventory/cost of sales, and liabilities/payables issues are significantly associated with reporting of ITWs. In joint tests both non-ITWs and financial misstatements are significantly associated with ITW reporting. Overall, the association of ITW reporting and non-ITW reporting is stronger than the relationship between ITW and financial misstatement reporting in SOX 404 auditors reports. Consistent with the results shown in Tables 6, company size is not significantly related to ITW reporting and Big 4 auditors are less likely to report ITWs. With respect to time period, whether or not ITW reporting increases in the time period after the change in auditing standards depends on both the direct effect of the time period and the offsetting interaction of time period and non-ITWs. Including an indicator variable for whether or not the financial statements are restated (Restate) improves model fit but does not change the direction or significance of coefficients (not in table).

SUMMARY AND DISCUSSION

This study asks three main questions about internal control weaknesses in financial reporting systems. To answer these questions we examine the relative frequency of ITW and non-ITW reporting in SOX 404 auditors' reports over the 2004 to 2009 period, evaluating the impact of key factors such as time, auditor type, company size, and industry. We examine the associations between 15 ITWs (and ITWs grouped according to the COSO framework), 20 non-ITWs and 26 financial misstatements using univariate and multivariate analyses. By studying the weaknesses reported in SOX 404 auditors' reports at a level of detail that is more granular than the groupings of controls used in prior studies, this study extends prior research on the associations of ITWs with non-ITWs and financial reporting consequences (Bell et al., 1998; Klamm and Weidenmier Watson, 2009; Messier et al., 2004) in several important ways.

In connection with RQ1, we found an overall downward trend in the number of ITWs reported between 2004 and 2009, with a particularly significant change between 2006 and 2007, around the time auditing standards changed. In other words, it appears that the reported level of internal control in companies with ITWs improved significantly between 2004 and 2009 but stayed comparatively constant for companies with internal control weaknesses that did not contain ITWs. An alternative explanation for this change is that auditing or reporting of internal control weaknesses in companies with ITWs, particularly for companies with Big 4 auditors, changed after 2006 so as to reduce the frequency of reported ITWs and related non-ITWs. Big 4 auditors (other auditors) identified proportionately fewer (more) ITWs and fewer non-ITWs for companies with fiscal year ends after 2006, when PCAOB Auditing Standard No. 5 became effective. In recent years, the number of reported ITWs has decreased significantly. These findings suggest that caution should be used when generalizing results of early SOX 404 studies to the present day and that analyses based on the first three years of SOX 404 reporting may not reflect current practice.

It is possible that the number and types of control weaknesses reported by auditors are representative of the underlying population of weaknesses, and that the actual frequency of ITWs has decreased significantly since the promulgation of SOX 404, particularly since 2007. It is also possible that the decline in the average number of ITWs and non-ITWs reported in recent years indicates SOX 404 reporting of ITWs is becoming potentially less informative due to the impact of the change in auditing standards in 2007 and the negotiation process between management and auditor that acts as a screen on what internal

control weaknesses are reported. Standard setters and regulators, including the SEC, should investigate this pattern of potentially less informative reporting compared to early years of SOX 404 reporting to determine whether the value of SOX 404 reporting is being undermined by current practice and whether additional guidance or training is required to improve current practice.

Another potential limitation of our analyses is our consideration of a limited number of influencing factors: time, type of auditor, company size, and industry. Other explanatory factors such as IT intensity of the firm, the firm's state of IT governance, and reliance on IT experts could play a critical role in determining the frequency and nature of ITWs. Examining such additional factors might be a fruitful research endeavour in the future.

Future study of the combination of *specific* ITWs and the small number of non-ITWs (lack of training, deficiencies in period end reporting processes and accounting policies, lack of segregation of duties, and inappropriate account reconciliation) associated with reporting the presence or absence of ITWs, may hold practical implications for an auditor's considerations of control testing and an educator's teaching of IT and non-IT controls. Our finding that model fit is improved by replacing the number of non-ITWs (financial misstatements) with individual non-ITWs (financial restatements) suggests such research may produce useful results. Similarly, future study of the associations between specific ITWs and specific financial misstatements may shed further light on the screening of reporting of ITWs in SOX 404 reports and provide managers, auditors, standard setters, regulators, and educators with relevant information about internal control issues to inform their respective policy considerations.

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REFERENCES

Bell, T.B., Knechel, W.R., Payne, J.L. and Willingham, J. J. (1998) An Empirical Investigation of the Relationship Between the Computerization of Accounting Systems and the Incidence and Size of Audit Differences, *Auditing: A Journal of Practice & Theory,* 17, 1, 13-38.

Boritz, J.E., Hayes, L. and Lim, J.H. (2012) A content analysis of auditors reports on IT internal control weaknesses: The comparative advantages of an automated approach to control weakness identification, *International Journal of Accounting Information Systems*, Advance online publication, doi:org/10.1016/j.accinf.2011.11.002.

Curtis, M.B., Jenkins, J.G., Bedard, J.C. and Deis, D.R. (2009) Auditors' Training and Proficiency in Information Systems: A Research Synthesis, *Journal of Information Systems,* 23, 1, 79-96.

Ge, W. and McVay, S. (2005) The disclosure of material weaknesses in internal control after the Sarbanes-Oxley Act, *Accounting Horizons,* 19, 3, 137–158.

IT Governance Institute (ITGI) (2006) Appendix I sample deficiency evaluation decision tree. IT control objectives for Sarbanes-Oxley: The role of IT in the design and implementation of internal control over financial reporting, 2nd Edition, Rolling Meadows, IL. USA. ISACA.

Janvrin, D., Bierstaker, J. and Lowe, D.J. (2009) An investigation of factors influencing the use of computer-related audit procedures, *Journal of Information Systems,* 23, 1, 97-118.

Klamm, B.K. and Weidenmier Watson, M. (2009) SOX 404 reported internal control weaknesses: A test of COSO framework components and information technology, *Journal of Information Systems,* 23, 2, 1-23.

Messier, W.F.Jr., Eilifsen, A. and Austen, L.A. (2004) Auditor detected misstatements and the effect of information technology, *International Journal of Auditing,* 8, 223-235.

Wolfe, C.J., Mauldin, E. G. and Chandler, M. C. (2009) Concede or deny: Do management persuasion tactics affect auditor evaluation of internal control deviations? *The Accounting Review* 84, 6, 2013-2037.